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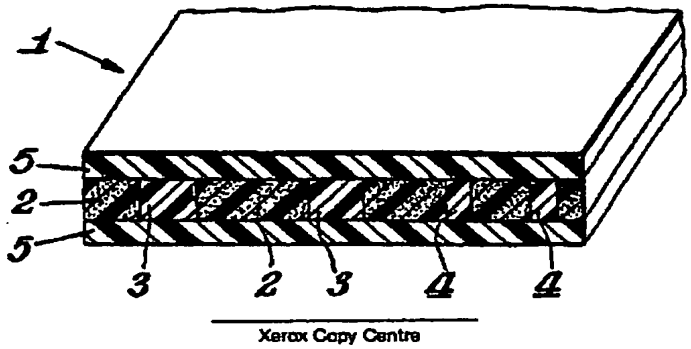
(54) Dielectric waveguide.

(57) A high frequency transmission circuit (1) is provided comprising a continuously porous, planar dielectric sheet (2) having an electromagnetic wave propagating circuit (3,4) therein formed by a dielectric material of a higher permittivity impregnated into portions of the dielectric sheet (2) in the thickness direction thereof. The planar dielectric sheet (2) is preferably of porous expanded polytetrafluoroethylene, and the dielectric material used to form the electromagnetic wave propagating circuit may be tetrafluoroethylene-hexafluoropropylene copolymer, a tetrafluoroethylene-perfluoroalkylvinyl ether copolymer, a tetrafluoroethylene-ethylene copolymer or a tetrafluoroethylene dispersion.

Fig.1.



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HIGH FREQUENCY TRANSMISSION CIRCUIT

This invention relates to a transmission circuit for the transmission of electromagnetic waves of extremely short wavelength, such as microwaves, millimetre waves and submillimetre waves, and particularly relates to a planar transmission circuit.

Coaxial cables, waveguides, microstrip lines, dielectric lines and other such devices are currently used to transmit these types of electromagnetic waves. In all of these devices, a core of round or rectangular cross-section is formed by a dielectric of low dielectric loss and relatively high permittivity for transmitting the travelling wave energy of the electromagnetic wave, and the core is surrounded by a dielectric of lower permittivity. Other forms of high frequency transmission device have not been considered, and there is thus a problem of how to form circuit networks and to increase circuit density.

According to the invention, there is provided a high frequency transmission circuit comprising a continuously porous, planar dielectric sheet having a dielectric material of greater permittivity than the dielectric sheet impregnated into portions of said dielectric sheet in the thickness direction thereof to form an electromagnetic wave propagating circuit in said planar dielectric sheet.

In other words, a high frequency transmission circuit is provided comprising a continuously porous, planar dielectric sheet having an electromagnetic wave propagating circuit therein formed by a dielectric material of higher permittivity impregnated into the dielectric sheet in the thickness direction thereof.

The dielectric material forming the electromagnetic wave propagating circuit may be a tetrafluoroethylene-hexafluoropropylene copolymer, a tetrafluoroethylene-perfluoroalkylvinyl ether copolymer, a tetrafluoroethylene-ethylene copolymer or a tetrafluoroethylene dispersion.

The planar dielectric sheet is preferably porous, expanded polytetrafluoroethylene.

It is desirable for the continuous pores of the porous, planar dielectric sheet to be aligned mainly in the thickness direction of the sheet, although even for a planar dielectric sheet whose porosity is unaligned, a similar impregnation result can be accomplished by using a masked impregnation method.

The invention provides a high frequency transmission circuit having good transmission characteristics and capable of being used to expand the circuit in the planar direction. Any desired high frequency circuit can be formed with a thin continuously porous, planar dielectric sheet by lamination or other methods. The creation of high density, high frequency transmission circuits can also be accomplished.

Preferred embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a schematic cross-sectional, perspective view of one embodiment of a high frequency transmission circuit in accordance with the invention; and

Figure 2 shows a partial sectional view illustrating one method of making a high frequency transmission circuit in accordance with the invention.

Figure 1 shows a high frequency transmission circuit 1 created by forming electromagnetic wave transmission portions 3 and 4 in portions of a porous, planar dielectric sheet 2, the latter being composed of continuously porous, expanded polytetrafluoroethylene film, and optionally laminating a protective film 5 to the upper and lower surfaces of the sheet 2. The protective films 5 may each be a prepreg sheet of porous, expanded polytetrafluoroethylene.

When expanded polytetrafluoroethylene film of permittivity 1.4 is used as the planar dielectric sheet 2, a powder of tetrafluoroethylene-hexafluoropropylene copolymer resin, tetrafluoroethylene-perfluoroalkylvinyl ether copolymer resin, tetrafluoroethylene-ethylene copolymer resin, or the like, with a permittivity of about 2, and a binder, or alternatively, a tetrafluoroethylene resin dispersion and a binder, may be impregnated and fixed in portions of the sheet 2 to form the electromagnetic wave transmission portions 3 and 4. The binder may be a Teflon (R.T.M.) adhesive.

These electromagnetic wave transmission portions 3 and 4 may be formed, for example, as shown in Figure 2, by applying an inverse pattern circuit mask 6 to the planar dielectric sheet 2, then applying the resin powder and binder composition to this circuit pattern portion and allowing natural impregnation to occur due to gravity, or applying a similar mask 6 to the bottom surface of the planar dielectric sheet 2 and facilitating impregnation by means of a vacuum pump 8.

When the composition 7 is dried after being impregnated in this way, electromagnetic wave transmission portions 3 and 4 are formed having a permittivity higher than the planar dielectric sheet 2.

In order to form electromagnetic wave transmission portions 3 and 4 with very sharp boundaries, it is desirable that the continuous porosity of the planar dielectric sheet 2 should be of the

smallest scale possible, and that the continuous pores should be aligned as much as possible in the direction of the thickness of planar dielectric sheet 2, i.e. perpendicularly to the plane of the sheet, or that the porosity should be high in the thickness direction.

Because the present invention allows a high frequency transmission circuit to be formed as a thin sheet, and the rectangular shape of the electromagnetic wave transmission portions maintains the plane of polarization, connections can be made without introducing significant error in the direction of the electromatic waves, and multiple layer devices can easily be produced.

Furthermore, because the invention relies upon impregnation into a continuously porous, planar dielectric sheet to form electromagnetic wave transmission circuit portions, thin devices can be produced and very high density transmission circuits can be made.

Claims

1. A high frequency transmission circuit characterised by a continuously porous, planar dielectric sheet (2) having a dielectric material of greater permittivity than the dielectric sheet impregnated into portions of said dielectric sheet in the thickness direction thereof to form an electromagnetic wave propagating circuit (3,4) in said planar dielectric sheet (2).

2. A transmission circuit according to claim 1, wherein the dielectric material of the electromagnetic wave propagating circuit (3,4) is a tetrafluoroethylene-hexafluoropropylene copolymer.

3. A transmission circuit according to claim 1, wherein the dielectric material of the electromagnetic wave propagating circuit (3,4) is a tetrafluoroethylene-perfluoroalkylvinyl ether copolymer.

4. A transmission circuit according to claim 1, wherein the dielectric material of the electromagnetic wave propagating circuit (3,4) is a tetrafluoroethylene-ethylene copolymer.

5. A transmission circuit according to claim 1, wherein the dielectric material of the electromagnetic wave propagating circuit (3,4) is a tetrafluoroethylene dispersion.

6. A transmission circuit according to any one of the preceding claims, wherein said planar dielectric sheet (2) is porous, expanded polytetrafluoroethylene.

7. A transmission circuit according to any one of the preceding claims, wherein the continuous pores of the planar dielectric sheet (2) are aligned mainly in the thickness direction of the sheet.

8. A transmission circuit according to any one of the preceding claims, having a protective film (5) laminated to at least one face of the planar dielectric sheet (2).

Fig.1.

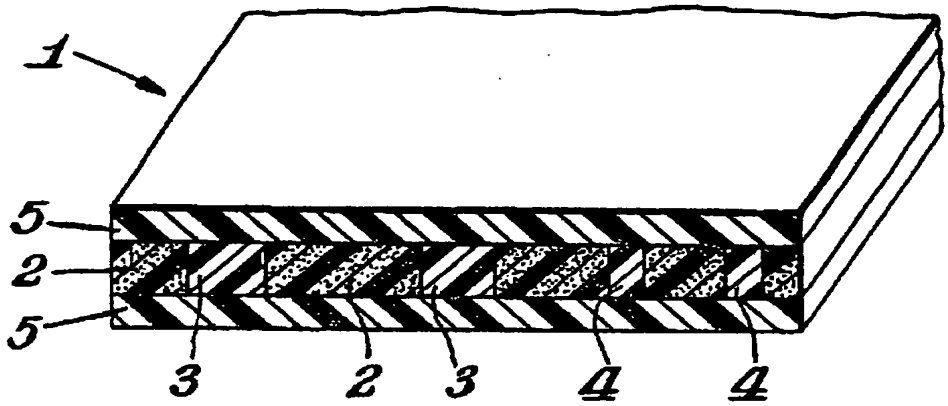
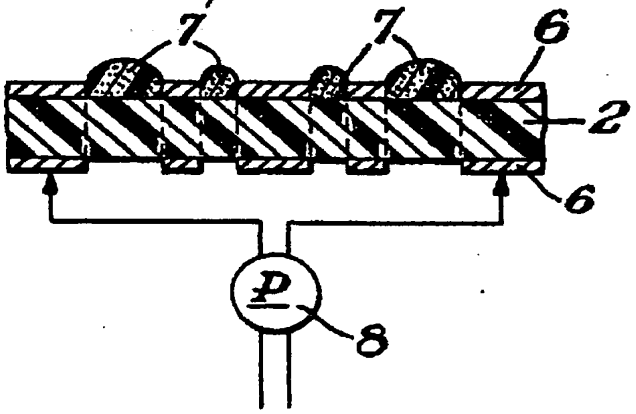


Fig.2.



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EUROPEAN SEARCH REPORT

Application Number

EP 89 30 8429

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A	FR-A-1 372 610 (PRACHE) * Page 2, left-hand column, line 53 - right-hand column, line 9; figure 3 *	1	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	09-11-1989	DEN OTTER A.M.

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X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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